

## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification:

B41F 15/42, H05K 3/12, B41M 1/12,  
B05D 1/32, 1/26

A1

(11) International Publication Number:

WO 98/16387

(43) International Publication Date:

23 April 1998 (23.04.98)

(21) International Application Number: PCT/EP97/05761

(22) International Filing Date: 13 October 1997 (13.10.97)

(30) Priority Data:

96/12671

15 October 1996 (15.10.96)

FR

97/01033

28 January 1997 (28.01.97)

FR

(71) Applicant (for all designated States except US): SOCIETE  
NOVATEC S.A. [FR/FR]; Z.A. Albasud, 170, rue L.  
Lepine, F-82000 Montauban (FR).

(72) Inventors; and

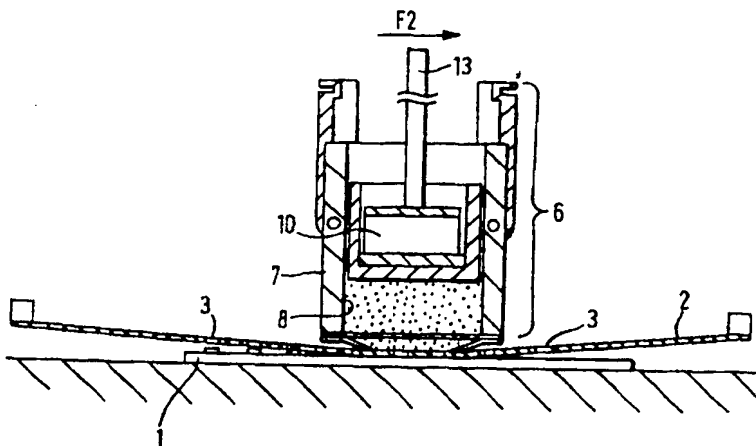
(75) Inventors/Applicants (for US only): BOURRIERES, Fran-  
cis [FR/FR]; 80, chemin des Cabouillous, Le Carreyrat,  
F-82000 Montauban (FR). KAISER, Clément [FR/FR]; 321,  
chemin des Cabouillous, Le Carreyrat, F-82000 Montauban  
(FR).(74) Agent: WILLIAMS, Janice; D. Young & Co., 21 New Fetter  
Lane, London EC4A 1DA (GB).(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR,  
BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE,  
GH, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK,  
LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO,  
NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR,  
TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH,  
KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ,  
BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE,  
CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL,  
PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN,  
ML, MR, NE, SN, TD, TG).

## Published

With international search report.

Before the expiration of the time limit for amending the  
claims and to be republished in the event of the receipt of  
amendments.

(54) Title: PROCESS AND APPARATUS FOR THE DEPOSITION OF A VISCOUS PRODUCT ON A SUBSTRATE VIA A STENCIL



## (57) Abstract

A method and device for carrying out the deposition of a viscous and/or pasty product on a substrate (1) through the apertures (3) of a stencil are provided. A hollow receptacle (7) for the product is provided with a lower aperture (19) which is orientated towards the stencil. The lower aperture (19) of the receptacle is delimited such that its length is adjusted to the dimensions of the substrate and that its width is a function of the speed of execution of the screen printing. This delimitation is implemented by sealing members (15, 16) preferably comprising two wipers (15) on respective sides of the aperture, transverse with respect to the direction of displacement of the receptacle, orientated one towards the other and inclined with respect to the horizontal between the wipers at an angle of between 120° and 180°, said wipers being transversal and intersecting with the section of the receptacle. A pressure is exerted upon the viscous product in the receptacle, which pushes it towards the stencil between the wipers to distribute it, and upon the wipers, applying pressure to these in order to push the wipers onto the stencil. The receptacle is displaced across the stencil at the same time as the pressure is being exerted on the product. The invention can be applied in the electronics industry for carrying out depositions of adhesive or soldering paste.

*FOR THE PURPOSES OF INFORMATION ONLY*

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

|    |                          |    |  |    |  |    |                          |
|----|--------------------------|----|--|----|--|----|--------------------------|
| AL | Albania                  | ES | Spain                                    | LS | Lesotho                                      | SI | Slovenia                 |
| AM | Armenia                  | FI | Finland                                  | LT | Lithuania                                    | SK | Slovakia                 |
| AT | Austria                  | FR | France                                   | LU | Luxembourg                                   | SN | Senegal                  |
| AU | Australia                | GA | Gabon                                    | LV | Latvia                                       | SZ | Swaziland                |
| AZ | Azerbaijan               | GB | United Kingdom                           | MC | Monaco                                       | TD | Chad                     |
| BA | Bosnia and Herzegovina   | GE | Georgia                                  | MD | Republic of Moldova                          | TG | Togo                     |
| BB | Barbados                 | GH | Ghana                                    | MG | Madagascar                                   | TJ | Tajikistan               |
| BE | Belgium                  | GN | Guinea                                   | MK | The former Yugoslav<br>Republic of Macedonia | TM | Turkmenistan             |
| BF | Burkina Faso             | GR | Greece                                   | ML | Mali   | TR | Turkey                   |
| BG | Bulgaria                 | HU | Hungary                                  | MN | Mongolia                                     | TT | Trinidad and Tobago      |
| BJ | Benin                    | IE | Ireland                                  | MR | Mauritania                                   | UA | Ukraine                  |
| BR | Brazil                   | IL | Israel                                   | MW | Malawi                                       | UG | Uganda                   |
| BY | Belarus                  | IS | Iceland                                  | MX | Mexico                                       | US | United States of America |
| CA | Canada                   | IT | Italy                                    | NE | Niger  | UZ | Uzbekistan               |
| CF | Central African Republic | JP | Japan                                    | NL | Netherlands                                  | VN | Viet Nam                 |
| CG | Congo                    | KE | Kenya                                    | NO | Norway                                       | YU | Yugoslavia               |
| CH | Switzerland              | KG | Kyrgyzstan                               | NZ | New Zealand                                  | ZW | Zimbabwe                 |
| CI | Côte d'Ivoire            | KP | Democratic People's<br>Republic of Korea | PL | Poland                                       |    |                          |
| CM | Cameroon                 | KR | Republic of Korea                        | PT | Portugal                                     |    |                          |
| CN | China                    | KZ | Kazakhstan                               | RO | Romania                                      |    |                          |
| CU | Cuba                     | LC | Saint Lucia                              | RU | Russian Federation                           |    |                          |
| CZ | Czech Republic           | LI | Liechtenstein                            | SD | Sudan  |    |                          |
| DE | Germany                  | LK | Sri Lanka                                | SE | Sweden                                       |    |                          |
| DK | Denmark                  | LR | Liberia                                  | SG | Singapore                                    |    |                          |
| EE | Estonia                  |    |  |    |  |    |                          |

## PROCESS AND APPARATUS FOR THE DEPOSITION OF A VISCOUS PRODUCT ON A SUBSTRATE VIA A STENCIL

The present invention relates to a method and device for carrying out the deposition of a viscous product on a substrate through the apertures of a stencil or  
5 screen, and may be applied in a screen printing machine.

The substrate can be a printed circuit on which electronic components have to be retained, then soldered. The viscous product can be a non-conductive or conductive adhesive or soldering paste or another silicon type viscous product. The  
10 stencil can be a screen printing stencil, either of the traditional type, that is to say a mesh or metallic stencil, or of the type which is the subject-matter of French patent no. 94.08518 of the present applicant, relating to a stencil allowing the deposition and the dosing of the products applied.

15 The examples of implementation of the invention are all within the area of deposition by screen printing of soldering pastes such as are used in the electronics industry to produce cards by soldering of components onto printed circuits. Nevertheless, the invention can find application in other technical fields.

20 The soldering pastes are heterogeneous materials, the components of which have different densities. The soldering pastes are composed of metallic materials and organic or flux materials. The mass of the metallic part represents approximately 85% to 90% of the total mass, with a density of 8 to 12 according to the metals used, and in volume terms it represents only approximately 50%. The organic material,  
25 also called flux, has a density of almost, or of, 1.

The soldering paste is constituted by metallic microspheres joined by the flux or organic material. This viscous flux comprises rheologic agents, adhesive agents and cleaning agents which affect the method of assembling components on printed  
30 circuits taking place in accordance with the following steps:

- deposition by screen printing of soldering paste contacts;

- placing of components on the paste contacts, the adhesive agent of which holds the components;
- reflow of the soldering paste in the furnace, which causes the coalescence of the metallic microspheres.

5

The function of the alloy constituted by the soldering paste is to provide the supply of metal necessary and strictly sufficient to ensure electrical interconnection between the pins of the components and the printed circuit by soldering. The organic materials in the paste must disappear at the conclusion of the soldering operation.

10 Nevertheless, there is generally a residue which must be cleaned with water or with solvent, which is both costly and polluting.

Soldering pastes supposed to have low residue have been developed. In these pastes, the organic part has substantially the same value in volume terms as in the

15 previous pastes, but the elements providing the different functions desired have a different behaviour. Light solvents with low boiling points are introduced to provide a proper rheology. Because of this, these solvents become volatile more rapidly and almost completely during the pre-heating operation which precedes the reflow step. At the end of the reflow step there thus remains little residue connected with this

20 function. In order to provide a satisfactory adhesive capacity, the light solvents described above are combined with adhesive resins which become volatile or sublime in the reflow step.

The cleaning agents for preparation of a surface which is suitable and is

25 indispensable for obtaining a satisfactory inter-metal connection occupy a very small part of the total volume of the paste, this being in order to reduce the residue connected with this function. As the overall efficiency of the cleaning must not change, the volume efficiency of the active cleaning constituent has to increase in the same proportions as the total amount of residue diminishes.

30

The consequence of this research into existing soldering pastes with the least

total amount of residue results, on the one hand, in a greater dilution of the active constituents in the paste and, on the other hand, in a greater volatility of the additional solvents used. It is therefore necessary that when the soldering paste is applied to the substrate, an extremely homogeneous distribution of the active constituent is obtained in all the elemental points of the volume of each deposit. If this is not achieved, adjacent or non-adjacent deposits of the solder paste will be obtained in which the efficacy of cleaning, for example, will not be identical. Certain points will be over-activated with a problem of residues and of cleaning, others will be under-activated and the soldering obtained will be of poor quality.

The high degree of solubility of the additional solvents used causes the problem of their evaporation during the operation of producing electronic cards. The fact that with the current modes of deposition the product is dragged by means of an inclined wiper (see Figure 1) in the open air does not allow this phenomenon to be overcome. This results in a change in the rheology of the soldering paste during production, which leads to the parameters for control of the machine being modified or, in extreme cases, to changing the soldering paste which may have become too dry and no longer passes properly through the apertures in the stencil.

Other elements add to this problem when production requirements necessitate high-speed screen printing, for example at 200 millimetres per second as opposed to 20 to 50 millimetres per second. Because of this thixotropic additives are introduced and combine with the other solvents. Evaporation of the base solvents therefore modifies the possible speed of deposition. By way of example, an evaporation of 1 % from the volume of soldering paste completely changes the rheology and makes screen printing very difficult, if not impossible.

Another of the problems caused by the known technology is the control of the wear and tear on the wiper system. Progressive erosion of the active edge of the wiper by rubbing alters the intrinsic qualities of the paste applied, and that of the depositions because of the uncontrolled and random retrieval of a certain quantity of

microspheres with each alternate wipe, the wipers being displaced alternately. In fact, the wipers are only changed when the poor quality of the deposition is a noticeable consequence of their wear.

5 In the known technology, two types of wipers are used:

- A rubber or polyurethane type, the hardness of which varies generally between 70 to 90 Shore. This wiper has the advantage of good deformation by virtue of its low degree of hardness and its flexibility, thus good sealing is produced. It has the inconvenience of deforming during passage over the  
10 apertures in the stencil. For apertures where the dimension parallel to the wiper is less than 0.5 mm, this is not a major problem. Where the apertures have dimensions parallel to the wiper greater than this value, the deposit is hollowed out. Where deposits are larger than 3 mm, they are completely dragged off again.

15 - A metallic type, the advantage of which is to maintain rigidity, which does not allow the deposit to be hollowed out, but the hardness of which, despite its flexibility, does not allow perfect sealing with the stencil to be produced. Its hardness sometimes exceeds that of the stencil and because  
20 of this there are scratches and encrustation of solder microspheres. The excessive pressure of the metallic wiper can also cause crushing of the tin-lead spheres, this alloy being much softer than the steel wiper.

25 Until now it did not appear that solutions had been found to eliminate these problems.

WO 96/20088 filed by the FORD MOTOR COMPANY claims a method and a device for distributing a viscous product by compression thereof through the apertures of a stencil. The device comprises a reservoir receiving a charge of viscous  
30 product; a pressure is exerted on the viscous material in the reservoir. This is linked via a conduit to a distribution nozzle, with a conical internal shape with baffle plates,

and provided with a rectangular distribution slit delimited by two wipers in opposite directions, slightly inclined with respect to the vertical. The two wipers bear against the stencil and keep it in contact with the substrate in the zone between them. The aim of this device is to allow implementation of high-speed screen printing.

5

It appears that the technology and the means disclosed by this patent not only do not permit the resolution of the problems described previously, but moreover accentuate them. Indeed, the viscous material has to be placed in a reservoir which is an integral part of the system. The viscous material has, following the reservoir, to be pushed under pressure towards the nozzle. The system according to Ford has disadvantages, in particular with regard to the cleaning of the circuit from the reservoir to the compression chamber. Further, the conical internal shape of the nozzle, and the baffle plates with which it is provided, in theory to guide and equalise the pressure, will have the effect of laminating the paste, which is hardly compatible with its heterogenous nature and the difference in density of the metallic parts and of the flux, this lamination creating a significant risk of separating the components and thus of deposits of unequal quality. In addition, according to Ford, the compression chamber bears upon the stencil, elasticity being obtained by the wipers, either under the effect of the pressure independent of that conferred to the product in the compression chamber or under the effect of springs acting on the wipers.

15  
20

Respective aspects of the present invention are set forth in claims 1, 4, 30 and 31.

25

Embodiments of the present invention provide a method and device for carrying out the deposition of a viscous product on a substrate through the apertures of a stencil or screen which allow the above problems to be solved.

30

Furthermore, preferred embodiments of the invention propose for screen printers a method and a device containing a viscous product which are directly adaptable, practically without modification, to existing screen printing machines,

which allow the product not to be handled in the open air, which avoid changes in the product, and which do not have a distributor to clean.

Furthermore, as will be set out in the description of preferred embodiments  
5 to follow, the device may be useable as a consumable distributor, thrown away after the viscous product it contains is used up, providing a solution to the problem of recycling by the suppliers of unused or incompletely used pots of pastes.

In one aspect, a method of deposition of a viscous product on a substrate  
10 through the apertures of a stencil or screen placed on the substrate is essentially characterised in that:

the viscous product is placed in a hollow receptacle acting as the container and provided with a lower aperture orientated towards the stencil on which said receptacle rests, said receptacle being mounted on a screen printing machine;

15 the lower aperture of the receptacle is delimited such that its length is adapted to the dimension of the substrate or of the zone of the substrate on which one or more deposits are to be made;

this delimitation of the lower aperture is done by sealing and wiper members comprising at least one longitudinal flexible wiper which is transverse with respect  
20 to the direction of displacement of the receptacle, said wiper being transversal to the direction of displacement of the product towards the aperture and of the pressure to which it is subjected at the level of the delivery of the product at an angle of between 120° and 180°;

a pressure is exerted in the receptacle upon the product and it pushes said  
25 product towards the stencil to distribute it and upon the flexible wiper by pressing on it to make it bear on the stencil and to make this bear on the substrate;  
together with this pressure, the receptacle is subjected to a movement of displacement on the stencil.

30 The delimitation of the lower aperture may be done by sealing and wiper members comprising at least two flexible wipers, each on either side of the opening,

transversal with respect to the direction of displacement of the receptacle, each wiper being transverse with respect to the push exerted on the product, said wipers being orientated oppositely, one towards the other, towards the aperture and having a slope with respect to the horizontal, in the zone of the aperture, of between  $120^\circ$  and  $180^\circ$ .

5

According to another embodiment of the invention, the pressure exerted in the hollow receptacle is constant from the piston to the distribution aperture.

According to another embodiment of the invention, the product exerts a pressure upon the wipers contributing to the sealing and to the forming of the contact between the stencil and the substrate.

10

According to another embodiment of the invention, the product is homogenised by mixing before reaching the aperture.

15

In one embodiment, of the invention, the device for deposition of a viscous product on a substrate through the apertures of a stencil placed on the substrate is essentially characterised in that it is constituted by a receptacle containing a quantity of product, that its cavity containing the product has parallel, rectilinear walls in which a piston moves, pushing the product towards an aperture delimited by sealing members, for example, wipers orientated in opposite directions at an angle of between  $120^\circ$  and  $180^\circ$  with respect to the horizontal on the deposition side; in the case of wipers at  $180^\circ$ , the extremity thereof can be bevelled or inclined towards the stencil.

20

According to another embodiment of the invention, a perforated grille is located in the receptacle above the aperture.

25

It appears that the invention makes use of a method and a device particularly suitable for transferring a viscous product.

30

The efficacy of the system in transferring a viscous product through an

aperture can be characterised by the following coefficient:

$$K = \frac{\text{contact time (T) x (PT) pressure of transfer}}{(\text{VI) viscosity}}$$

5 T being the duration for which the product to be transferred is in contact with the aperture.

PT being the pressure to which the product to be transferred is subjected,  
VI being the viscosity.

K is a non-unitary value which is proportional to the efficacy of the transfer.

10 The greater the value K, the more easily the product will be transferred.

The following description of preferred embodiments will allow it to be understood that the invention satisfies all the conditions set out hereinabove.

15 Other advantages and features of the invention will become evident from reading the description hereinafter of preferred embodiments of the invention, given by way of a non-limiting example and illustrated by the attached drawings, in which:

Figure 1 schematically shows an operation of deposition of a viscous product by screen printing according to the prior art;

20 Figure 2 is a view in transverse section of a device embodying to the invention;

Figure 3 is a view in transverse section of the device according to Figure 2;

Figure 4 is a view in longitudinal section of the device according to Figure 2;

25 Figure 5 shows, in a transverse section view, the pressures exerted in the device and on the stencil and the substrate;

Figure 6 shows the means of separation between the device and the stencil so that it can be removed;

Figure 7 shows the homogenising grille;

30 Figure 8 shows the wipers;

Figure 9 shows a view in transverse section of another embodiment of the device according to the invention;

Figure 10 is a view in longitudinal section of a device for the deposition of pasty or viscous product with an intermediate receptacle embodying to the invention.

Figure 11 is a perspective view of the intermediate receptacle with its cover;

Figure 12 is a view in transverse section of the device according to Figure 10;

5 Figure 13 is a device for mixing the product in an embodiment of the invention.

Figure 1 shows the implementation of making deposits onto a substrate 1 through a stencil or a screen 2 provided with apertures 3, by means of a wiper 4.  
10 The product to be applied is labelled 5.

A standard wiper 4 inclined at an angle which can vary from  $60^\circ$  to  $45^\circ$  with respect to the horizontal fulfils several functions at the same time:

- it drags the product to be deposited over the stencil;
- 15 - it transfers it through the apertures 3 in the stencil or the screen 2.

The force of transfer can only be exerted if there is displacement of the wiper. This force is not constant over the whole length of the wiper. It is at its maximum at the end of the wiper and it decreases along the strip. Because of this the  
20 result of the transfer is directly linked to the viscosity of the product, wherein it is known that this will change quickly, and to the force of transfer resulting from the sloping of the wiper and from its movement.

At the point of contact between the wiper and the stencil, the wiper fulfils a  
25 triple function:

- sealing (with regard to the apertures in the stencil);
- wiping the stencil, which allows removal of the surplus product;
- contact between the stencil 2 and the substrate 1, there being no contact  
30 downstream and upstream of the wiper.

The fact that a single tool, the wiper, fulfils all these functions makes

independent action with respect to each of these functions impossible within the known technology. Moreover, this known technology has disadvantages. The product to be distributed through the apertures is always downstream of the wiper which establishes a contact on its bearing line upon the stencil. Because of this, as shown in Figure 1, when the filling of the aperture takes place, it is always in a zone where the stencil is not in contact with the substrate. Because of this, as shown in Figure 1, the product can be pushed in between the stencil and the substrate, making on the one hand undesirable lines on the substrate and on the other hand fouling the stencil which must be cleaned frequently.

10

The disadvantageous non-contact in the actual deposition of the product nevertheless has the advantage of aiding the unmoulding of the deposit, as shown by 3B of the same figure. The ideal is to obtain non-contact equal to zero at the time of deposition and greater than zero following the deposition.

15

The embodiments of the invention to be described allow the essential functions to be dissociated, that is to say dragging, transfer of the viscous product and wiping of the excess, while providing the original solutions to the other functions: contact and non-contact, sealing, quality of deposits, and to the problems posed by the variations in rheology of the product or by its heterogeneous nature.

20

The method embodying to the invention for making deposits of a viscous product on a substrate 1 through the apertures in a stencil 2 or a screen involves containing a quantity of viscous product in a hollow receptacle. Preferably, this hollow receptacle and its members and accessories, which will be described later, is designed as a disposable or recyclable container (for factory filling) delivered directly from the factory with a quantity of viscous product to be deposited. This arrangement allows handling of the bulk viscous product, using a spatula, from the pot in which it is traditionally delivered, to be avoided. As the device is designed to be installed directly onto the screen printing machine for producing electronic cards, it can be removed either when it is empty or after use.

25

30

According to the method, in the hollow receptacle a pressure is exerted on the viscous product, which is pushed towards a lower aperture in the receptacle directed towards the stencil. The length of this aperture is preferably adapted to the dimensions of the substrate on which the different deposits are to be made, or of the zone of the substrate on which the deposits are to be made; actually the width of the aperture is adapted to the more or less rapid speed of displacement of the device on the stencil and thus directly in relation to the speed at which the screen printing has to be done.

10 A high printing speed can be obtained without adding additives to the paste to modify the rheology of the paste.

The lower aperture of the receptacle containing viscous (or pasty) product is delimited by sealing and wiping members. The pressure exerted on the product in the receptacle contributes to exerting a pressure upon said receptacle, by means of the sealing and wiping members, onto the stencil and the substrate, which, as described hereinafter, contributes both to making a zone of contact between the stencil and the substrate, this zone being facing the aperture between the sealing members which delimit this aperture, and to pressurising the sealing members and wiping off the excess product. The contact zone contributes to good transfer of the product through the apertures of the stencil, without smears under the stencil, or excess. This contact zone moves on the stencil at the same time as the device, the non-contact being made upstream following passage of the sealing wiping members.

25 According to the method to be described, the pressure exerted in the receptacle on the product remains constant as far as the distribution aperture and contact with the stencil. This pressure in the device is exerted by the product upon the sealing wiping members which delimit the delivery aperture and are transversal to the direction of downward delivery of the product, which contributes to increasing the sealing function.

30

According to the method to be described, the surface on which the pressure is exerted in the container on the product is larger than the distribution aperture delimited by the sealing members and a pressure is exerted by the product upon the stencil at the level of the aperture and a pressure is exerted by the product on the  
5 sealing members which are both partially transversal to the section of the container and to the downward direction of displacement of the product.

The uniformity of the amount of pressure exerted in the cavity of the receptacle or container, the internal walls of which are rectilinear and/or parallel,  
10 avoids dissociation of the components of the product because of differences in density of said components.

The method embodying the invention furthermore has a phase of homogenisation of the active constituent of the product. This phase is carried out  
15 under the influence of the pressure exerted on the product in combination with a homogenising member which will be described hereinafter. Preferably, this homogenisation is obtained by division into parts of identical volume in the zone  
between the receptacle itself and the distribution aperture delimited by the sealing members. The action of the wipers as the receptacle is displaced also assists this  
20 homogenisation as discussed further below.

Figure 2 shows a view in transverse section of the device for implementing the method; this view is complemented by Figure 3 which is a view in partial transverse section, and by Figure 4 which is a view in longitudinal section.  
25

Figure 2 shows the substrate 1, resting on a table, the stencil or screen 2 provided with apertures 3 and the distribution device 6 for the product. The distribution device is constituted by a receptacle 7 or container, the internal wall or walls of which is or are rectilinear and parallel. In the internal cavity of the  
30 receptacle 7, the walls of which are vertical, a charge of product, for example of soldering paste, labelled 9, is placed, for example in the factory.

A piston 10 is movably mounted in the internal cavity of the receptacle. The piston has a head 11 (Figure 3), the surface of which is planar. It is provided with vertical walls 12 behind its planar head, which slide on the vertical wall or walls of the receptacle and contribute to the guiding of the piston. A vertical pressure is exerted on a rod 13 of the piston (Figure 2) according to the arrow F1 of Figure 3. This vertical pressure is delivered to the rod 13 of the piston by a pressure source and a member of the screen printing machine capable of transmitting this pressure. This pressure is exerted in a uniform manner upon the product 9, the hollow receptacle containing the product and the piston having the same section from top to bottom.

The receptacle is open towards the bottom by means of a distribution aperture 14, delimited by sealing members 15 and 16 and an aperture 19. At the base of the receptacle there is arranged a transversal member 17 for homogenisation by division of the pasty and viscous product having a heterogeneous composition. This member is constituted by a perforated grille or by a perforated wall, the perforations of which are, as shown in Figure 7, all of the same size and made according to a constant spacing and pitch. Preferably, the perforations 18 of the grille are circular. The grille fulfils both a function of holding the product in the cavity of the receptacle and of transmitting the pushing of the piston to the device which is pushed onto the stencil.

Below the grille there are arranged the sealing members which delimit the aperture 19 (Figure 3) for delivering the product. The aperture 19 is of smaller dimensions than the receptacle as shown in Figure 3. The sealing members 15 are shown in Figures 2 and 3 with the device embodying to the invention, and by themselves in Figure 8. The sealing members 16 are shown in Figure 4, which is a view in longitudinal axial section of the device.

The members 15 are wipers fixed by a part 15A to the wall of the receptacle, and a part 15B of which is transversal to the lower section of the receptacle and to the direction of descent of the product under the pressure of the piston. The wipers

are mounted opposite one another, their inclined parts 15B being facing and in opposite directions. The inclination of their part 15B is greater than vertical, and can be between  $120^\circ$  and  $180^\circ$  with respect to the horizontal in the zone of distribution of the product onto the stencil following the angle (Figure 3). In the case  
5 in which the wiper is inclined at  $180^\circ$ , its extremity can be bevelled or inclined. The angle formed by the wiper and the substrate or the stencil outside the zone where the product is delivered at the level of the aperture 19 is of a value which is complementary to those previously set out.

10 The wipers 15 can be of any suitable material, metal or synthetic materials; they must be of a hard, flexible material which is deformable without exceeding the elastic limit. Advantageously, wipers such as described are arranged on the long longitudinal sides of the device and approach the stencil and the substrate transversally. Each wiper 15 has the function of lifting, by detachment, the excess  
15 product remaining on the stencil. This functioning is more efficient than the wiping according to Figure 1 in which the product is pushed by the wiper.

The transverse sides or short sides of the device, which has the shape of a rectangular parallelepiped, can either be provided with wipers providing sealing as  
20 described previously, or be provided with sealing members 16 such as are shown in Figure 4 and which can be constituted either by a profiled section in a flexible material, or by an elastically deformable profiled section which can, for example, be constituted by a profiled section which is hollow or made from closed cell foam. The essential function of the members 16 is that of lateral sealing intended to avoid  
25 overflow of the product by creep, as shown in Figures 2 - 5.

Advantageously it can be envisaged that the device is provided with only one wiper such as 15 in a flexible material, and that the other edges of the aperture are provided with sealing members such as 16. In this case, the device could only  
30 function in one direction.

The pressure (according to the arrow F1 or to the rod 13) exerts a pressure on the pasty and/or viscous product constituting the soldering paste. Together with this pressure, a displacement movement according to the arrow F2 or in the opposite direction is provided to the device to allow it to cover the surface of the stencil and of the substrate. The vertical pressure of the piston in the receptacle pushes the pasty product both through the lower aperture 19 towards the stencil and the substrate, through the grille 17 (not shown in Figure 5) and on the sealing members 15, which contributes to keeping them pressurised and to wiping off the excess product by simultaneous displacement with the device.

The inclination of the wipers as defined hereinabove, and which is slight with respect to the stencil, contributes to detaching and lifting the excess product which remains in the zone delimited by the grille 17 and the lips of the wipers. As the wipers 15 are arranged in opposite directions, the function of wiping is done whatever the direction of displacement of the device.

The grille 17 functions as a homogenising element for the paste or soldering paste by division thereof, in that it leaves the grille in separate strings or small rods, the section of which corresponds to that of each of the perforations in the grille, said strings or rods re-agglomerating by rubbing on the stencil or the screen. The open surface of the grille can be 20% to 90% of the total surface of the grille.

The lower distribution aperture 19 can be of dimensions adapted according to the speed of application desired and/or the viscosity of the product to be deposited.

The invention is applicable to the application of very high viscosity products as well as to very low viscosity products. This adaptation of the aperture 19 can relate essentially to its width, that is to say the distance between the lips 15B of the wipers 15 which, for this purpose, can be interchangeable, for example if the container device and its internal receptacle has a constant given section. It is also possible to envisage that the section (the width of the receptacle and of the piston) is different and more or less large, with an aperture 19 between the more or less large lips 15B,

where the different devices are adapted to a certain rheology. The length of the device, as set out above, is such that the length of the aperture 19 covers the whole of the width of the substrate and/or of the stencil or of the zone on which the deposits are to be made.

5

When the deposit is made by displacement of the device together with the pressure exerted on the piston, the contact surface of the product, determined by the dimensions of the aperture 19, being large, it is inconceivable to lift the receptacle distributor device off the stencil.

10

According to an embodiment of the invention this removal is done by detachment of the mass of product obtained by interposing a wall between the wipers and the product on the one hand, and the stencil on the other hand. Advantageously, as shown in Figure 6, the receptacle is provided with at least one wall 20. This wall 20 is carried by any suitable member which allows it to be positioned outside the field of the aperture 19, or below it. Preferably, this wall 20 is a flexible, rigid or semi-rigid wall acting as a blade. In the embodiment shown in Figure 6, the wall 20 is carried by an articulated and moveable flap 21 in order to occupy the positions such as shown in broken lines. Preferably, the flap is articulated on the external face of the receptacle, and it is placed in the upper position during the phase of displacement of the device. Preferably, the device comprises two walls 20 and two flaps 21 articulated on each of its external front and rear faces.

The grille can be removable and/or interchangeable according, for example, to the proportion of open surface which it is to be given.

Figure 9 shows a view in transversal section of an embodiment of the device in which the grille 17 and the lip or lips 15 are carried by a device 22 which can be fixed, such that it can be dismantled, below the receptacle and allows the mounting and dismantling of the grille and or the wiper or wipers and the changing of one or the other of the grille and wiper assembly.

The distribution receptacle device 6 embodying to the invention is designed to function in a sealed manner by contact with the stencil and the substrate. This sealing allows products which are sensitive to humidity such as, for example, silicones, to be delivered.

5

The aperture 19 can be covered over by a cover (not shown) prior to use of the device, which can be glued below the grille and which can be peeled or torn off.

Figure 10 shows a view in longitudinal section of an embodiment of the device for deposition of pasty or viscous product with an intermediate product receptacle.

The product 9 is contained in an intermediate receptacle 23 closed at the top with a sliding cover 24, which is introduced into the cavity of the receptacle and the piston 10 pushes the product in this intermediate receptacle by bearing on the sliding cover. The intermediate receptacle is a charge filled at the factory directly by the product manufacturer.

The intermediate receptacle shown in Figure 11 has a shape corresponding to that of the internal cavity of the receptacle of the device. These walls are vertical with an aperture at the top and at the bottom. These apertures can be covered in the factory after filling by any known means and uncovered at the time of installation.

Advantageously, the intermediate receptacle is provided with means for locking it in the housing of the device which is preferably a shoulder 25 totally or partially peripheral on its top edge. This intermediate receptacle has smooth and rectilinear internal walls. It is designed as a disposable or recyclable cartridge. The cover 24 rests on the pasty product. The cover 24 shown in Figure 11 is a planar plate with dimensions slightly smaller than the top aperture of the receptacle so that it can slide in the receptacle under the pressure of the piston which pushes the pasty product.

The significance of this improvement is that it simplifies the manufacture of the device, the cost of which can be less high, and that it facilitates the handling of the pasty or viscous product and/or its mixing or heating prior to use; it also facilitates loading.

5

According to another embodiment of the invention, the intermediate receptacle 23 can integrate functions of the device which receives it; in particular it can be provided at the level of the lower aperture with an openwork grille 17 and its aperture can be delimited by sealing members 15, the lips of which are in opposite directions.

10 The construction facilitates production; the grille and the lips can be moulded with the intermediate receptacle.

Figure 13 shows a product mixing device fitted to the receptacle embodying the invention used before installation on the machine. It comprises a planar plate 26, preferably rigid, under the aperture, which is substituted for the stencil. The device is guided, for example by means of a rail which is not shown, or any other mechanical means, parallel to the plate. A pressure is exerted by a piston 27 which can be of the same type as the piston 10 and which bears upon the product 9 which passes through the grill 17.

20

The forward movement, that is to say from left to right, causes the setting in motion and the rotation of the paste and its agitation and its homogenisation at the time of passage through the apertures of the grille in the clockwise direction. The backward movement, that is to say from right to left, causes the setting in motion, the rotation and the homogenisation of the paste in the opposite direction. Several forward-backward movements provide mixing of the soldering paste, the wipers lifting the paste as shown by the arrows in the figure, so that the paste passes upwards through the grille and is pushed back downward through the grille by the piston. This gives the paste the rheological qualities suitable for its application from the start of its use, whether for new cartridges or for cartridges which still contain some product and which have to be re-used after a downtime. It will of course be

30

appreciated that this rotation and homogenisation of the paste also occurs during displacement of the device 6 in a printing operation.

The device embodying the invention does not require high working pressures.

5

As it is designed as a sealed container, the device embodying the invention eliminates the operations of cleaning the devices according to the prior art and fulfils the health and safety criteria for the users, who do not have to come into direct contact with product.

10

According to the criteria of application and/or the nature of the products to be deposited, a distribution device embodying the invention can be insulated and/or provided with a thermostat, heated or cooled, without it being necessary to provide this insulation or conditioning for the whole machine, as was the case with the prior art.

15

It will of course be appreciated that, while various preferred embodiments of the invention have been described above, many changes and modifications may be made without departing from the scope of the invention.

20

CLAIMS

1. A device for deposition of a viscous product on a substrate through the apertures of a stencil placed over the substrate as the device is displaced over the  
5 stencil, the device comprising:

a hollow receptacle (7) for the product having an aperture (19) towards which the product is pushed under pressure in use with the aperture (19) orientated towards the stencil;

wherein the aperture is delimited by sealing and wiper members (15, 16)  
10 comprising at least one longitudinal flexible wiper (15), the wiper being transverse to the direction of displacement of the device over the stencil and transverse to the direction of displacement of the product towards the aperture under pressure;

and wherein the wiper (15) is inclined at an angle of 120° to 180° with respect to the horizontal in the zone of the aperture and arranged such that, when the  
15 product is pushed towards the aperture under pressure in use, the product is pushed against the wiper to push the wiper against the stencil.

2. A device according to claim 1, including means (10) for applying pressure to the product in the receptacle.  
20

3. A device according to claim 2, wherein the means for applying pressure comprises a piston (10) which is movably mounted in the receptacle (7).

4. A device for the deposition of a viscous and/or pasty product on a substrate  
25 through the apertures of a stencil placed on said substrate, characterised in that it is constituted :

by a hollow receptacle (7) forming the product container;

in that a piston (10) is movably mounted in the cavity of the hollow receptacle, pushing the product towards an aperture orientated towards the stencil;

30 wherein the aperture is delimited by sealing members (15, 16) comprising at least one longitudinal wiper, transverse with respect to the direction of displacement

of the receptacle, said wiper being inclined at  $120^{\circ}$  to  $180^{\circ}$  with respect to the horizontal in the zone of the aperture;

and wherein the wiper is transverse with respect to the section of the cavity of the receptacle and to the direction of the pressure exerted on the product.

5

5. A device according to claim 3 or claim 4, characterised in that the head of the piston is planar.

6. A device according to any preceding claim, wherein the sealing and wiper members include at least two sealing members (16) disposed on respective lateral sides of the aperture (19) at each end of the flexible wiper (15) to provide lateral sealing.

7. A device according to any preceding claim, characterised in that the lower aperture (19) of the receptacle is delimited by sealing and wiper members comprising at least two flexible wipers (15) on respective sides of the aperture, transverse with respect to the direction of displacement of the receptacle, said wipers which are transversal with respect to the direction of the pressure exerted upon the product, being orientated opposite, one towards the other, towards the aperture (19) and having a slope with respect to the horizontal in the zone of the aperture between  $120^{\circ}$  and  $180^{\circ}$ .

8. A device according to any preceding claim, characterised in that the dimensions of the aperture (19) delimited by the sealing and wiper members is in accordance with the dimension of the substrate or of the zone of the substrate (1) where the deposits are to be made and the speed at which the screen printing is to be carried out and/or the viscosity of the product to be deposited.

9. A device according to any preceding claim, characterised in that a perforated grille (17) is arranged transversally with respect to the receptacle, above the aperture.

10. A device according to claim 9, characterised in that the coefficient of aperture of the grille is between 20% and 90%.

11. A device according to claim 9 or claim 10, characterised in that the grille (17)  
5 is removable and can be changed.

12. A device according to claim 11, characterised in that the grille (17) and the wiper or wipers (15) form an assembly removable from the receptacle.

10 13. A device according to any preceding claim, characterised in that the internal section of the receptacle (7) is constant.

14. A device according to any preceding claim, characterised in that the internal walls (8) of the receptacle are vertical and orthogonal to the plane formed by the  
15 stencil (2) and the substrate.

15. A device according to claims 9 and 14 characterised in that the grille (17) and the internal walls of the receptacle are orthogonal.

20 16. A device according to any one of claims 1 to 12, characterised in that the walls (8) of the cavity of the receptacle are vertical, parallel and rectilinear, said receptacle having a constant section.

17. A device according to any preceding claim, characterised in that at least one  
25 wall (20) is interleavable between the stencil and the sealing members below the aperture for removal of the device.

18. A device according to any preceding claim, characterised in that before use, a cover covers over the aperture (19).

30

19. A device according to any preceding claim, characterised in that the product

is contained in a removable intermediate receptacle (23) introduced into the receptacle (7).

20. A device according to claim 3 and claim 19, or claim 4 and claim 19,  
5 wherein the piston (10) is arranged to slide in the intermediate receptacle (23).

21. A device according to claim 20, characterised in that the intermediate receptacle is open at the top for passage of the piston (10).

10 22. A device according to any one of claims 19 to 21, characterised in that the intermediate receptacle (23) has the same shape as the internal cavity of the receptacle and has vertical walls.

23. A device according to any one of claims 19 to 22, characterised in that the  
15 intermediate receptacle is open at its bottom to allow the exit of the product under applied pressure.

24. A device according to claim 23, characterised in that the lower aperture of the intermediate receptacle is delimited by the sealing members.

20

25. A device according to any one of claims 19 to 24 wherein said sealing and wiper members are mounted on the intermediate receptacle.

26. A device according to any one of claims 19 to 25, characterised in that the  
25 intermediate receptacle comprises a perforated grille (17) at the level of its bottom aperture.

27. A device according to any one of claims 19 to 26, characterised in that the receptacle is provided with a cover which slides in said receptacle.

30

28. A device according to claim 27, characterised in that the cover has

dimensions slightly smaller than the aperture.

29. A device according to any preceding claim for applying solder paste to a printed circuit board.

5

30. Apparatus for deposition of a viscous product on a substrate, comprising a stencil (2) for location over the substrate and a device as claimed in any preceding claim, the arrangement being such that, when the product is pushed under pressure towards the aperture in use, the product is pushed against the or each wiper to push  
10 the wiper onto the stencil and the stencil onto the substrate.

31. A method for deposition of a viscous product on a substrate through the apertures of a stencil (2) placed over the substrate, the method comprising:

15 locating a device as claimed in any one of claims 1 to 29 over the stencil with the aperture (19) of the device orientated towards the stencil, the device containing the product to be deposited in the receptacle thereof;

applying pressure to the product in the receptacle to push the product towards the aperture so that the product is pushed against the or each wiper, pushing the wiper onto the stencil and the stencil onto the substrate;

20 while said pressure is applied, displacing the device over the stencil.

32. A method for carrying out the deposition of a viscous product on a substrate through the apertures of a stencil or screen resting on said substrate, characterised in that:

25 the viscous product is placed in a hollow receptacle (7) serving as a container, provided with a lower aperture (19) orientated towards the stencil on which said receptacle rests, said receptacle being mounted on a screen printing machine;

the lower aperture (19) of the receptacle is delimited such that its length is adjusted to the dimensions of the substrate or of the zone of the substrate on which  
30 a deposit or deposits are to be made;

this delimitation of the lower aperture is by sealing and wiper members (15,

16) comprising at least one longitudinal flexible wiper (15) transverse with respect to the direction of displacement of the receptacle, said wiper being transverse with respect to the direction of displacement of the product towards the aperture and of the pressure exerted on it at the level of the delivery of the product, an angle of between  
5 120° and 180°;

a pressure is exerted in the receptacle upon the product, and pushes it towards the stencil (2) to distribute it, and upon the flexible wiper (15), applying pressure to it in order to push it onto the stencil and to push said stencil onto the substrate;

together with this pressure, the receptacle is subjected to a movement of  
10 displacement on the stencil.

33. A method according to claim 31 or claim 32, characterised in that the delimitation of the lower aperture is by sealing and wiper members comprising at least two flexible wipers (15), each on either side of the aperture (19), transverse with  
15 respect to the direction of displacement of the receptacle, each wiper being transverse with respect to the pressure exerted upon the product, said wipers being orientated oppositely, one towards the other, towards the aperture (19) and being inclined with respect to the horizontal in the zone of the aperture between 120° and 180°.

20 34. A method according to claim 33, characterised in that the excess product is lifted from the surface of the stencil (2) by the wiper or wipers (15).

35. A method according to claim 33 or claim 34, characterised in that the displacement of the receptacle is alternate, in one direction and then in the other.

25

36. A method according to any one of claims 31 to 35, characterised in that the pressure exerted in the receptacle is constant.

37. A method according to any one of claims 31 to 36, characterised in that the  
30 width of the aperture (19) delimited by the sealing members (15, 16) is less than the width of the receptacle on which the pressure is exerted.

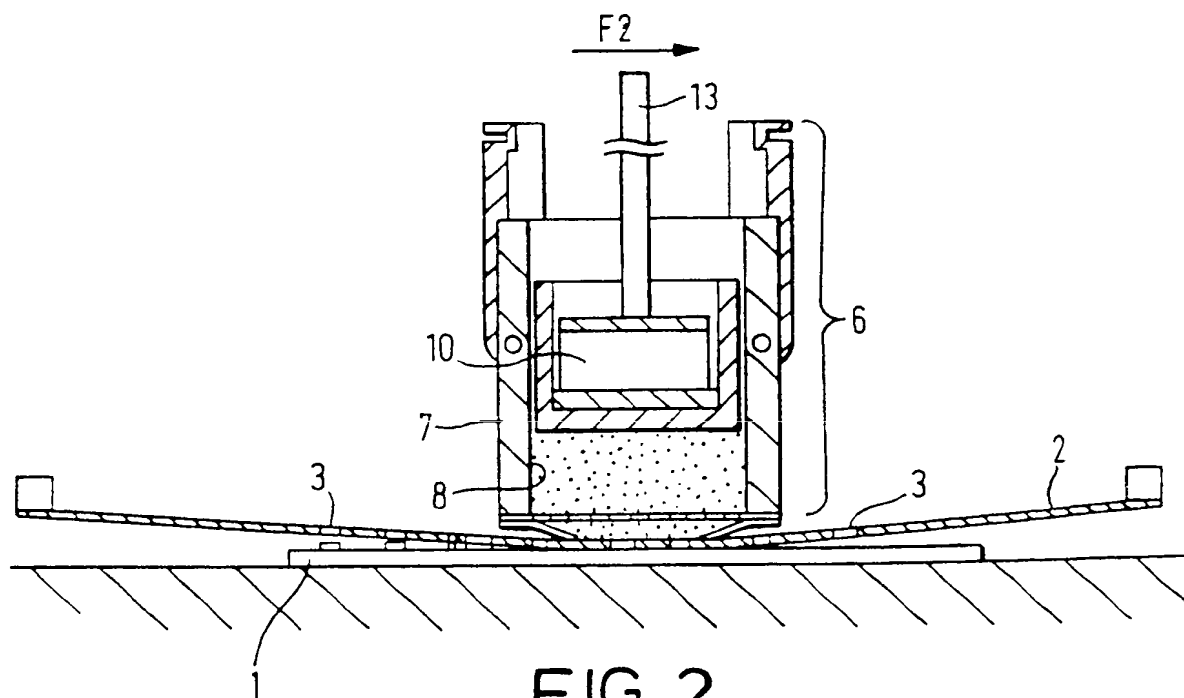
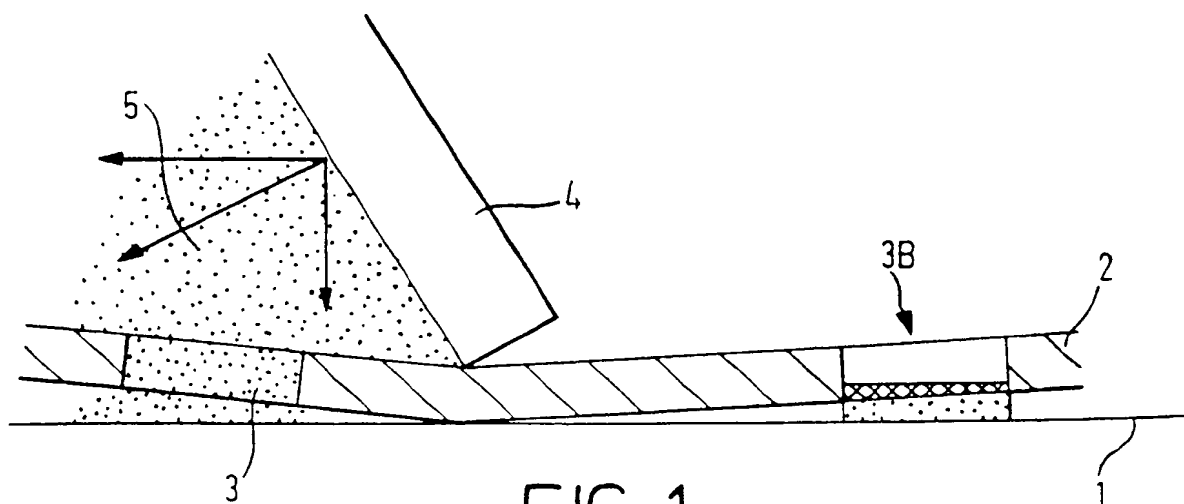
38. A method according to any one of claims 31 to 37, wherein the dimensions of the aperture (19) are determined in accordance with the dimension of the substrate or of the zone of the substrate (1) where the deposits are to be made and the speed at which the screen printing is to be carried out and/or the viscosity of the product  
5 to be deposited.

39. A method according to any one of claims 31 to 38, characterised in that the product is homogenised by mixing before distribution through the aperture.

10 40. A method according to claim 39, wherein prior to location of the receptacle over the stencil for a printing operation, the receptacle is moved from front to back on a non-perforated plate (10) as pressure is exerted on the product, thereby to effect mixing of the product.

15 41. A method as claimed in any one of claims 31 to 40 for applying solder paste to a printed circuit board.

1/8



2 / 8

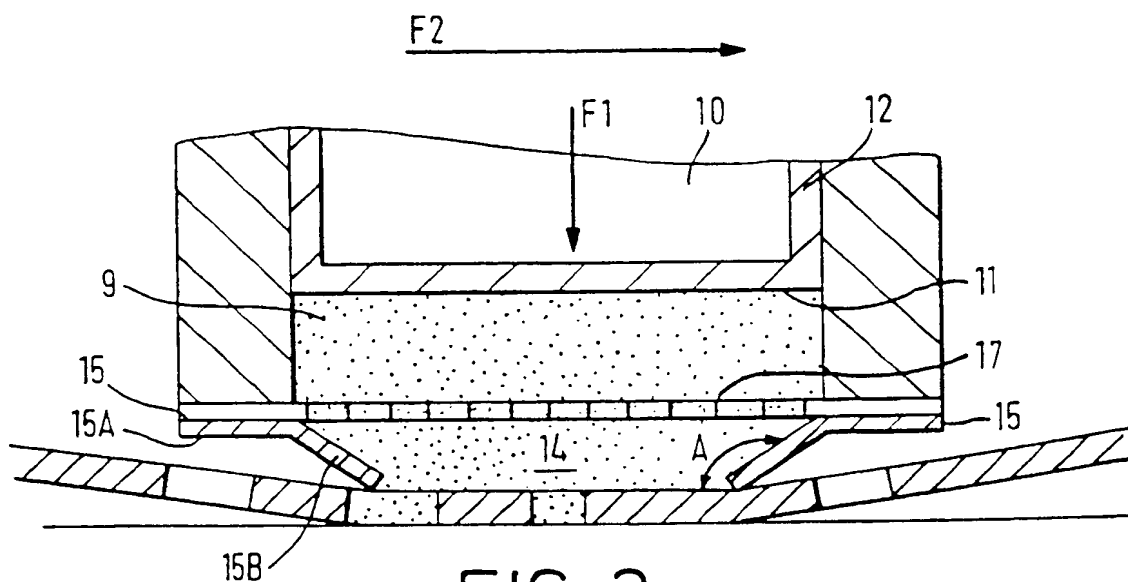


FIG. 3

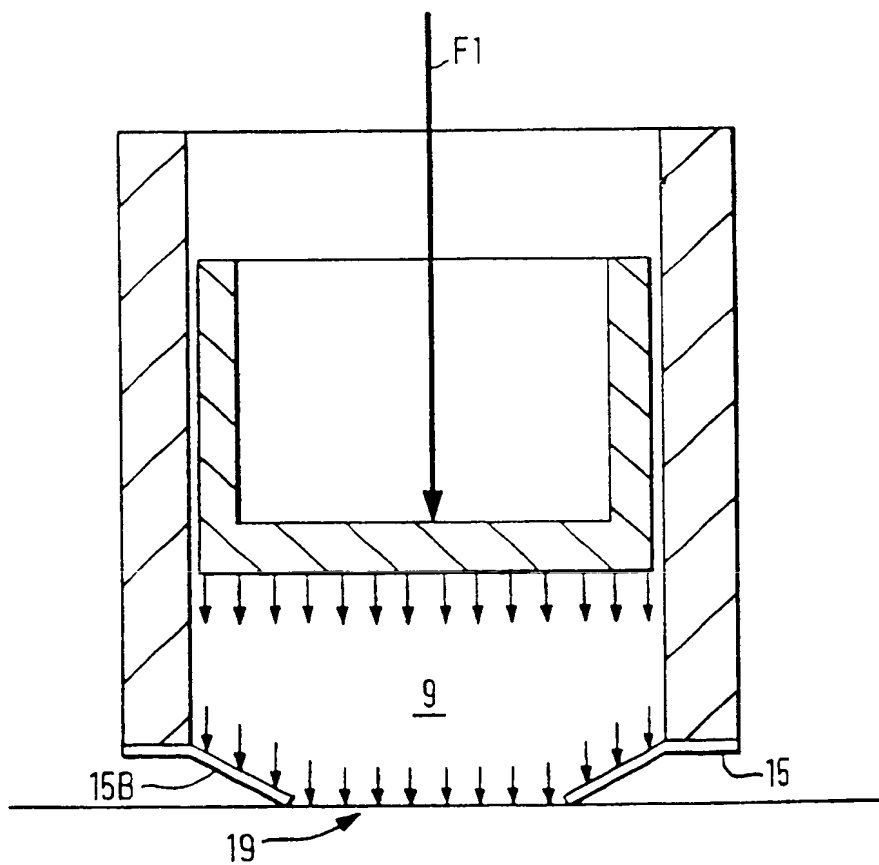


FIG. 5

3 / 8

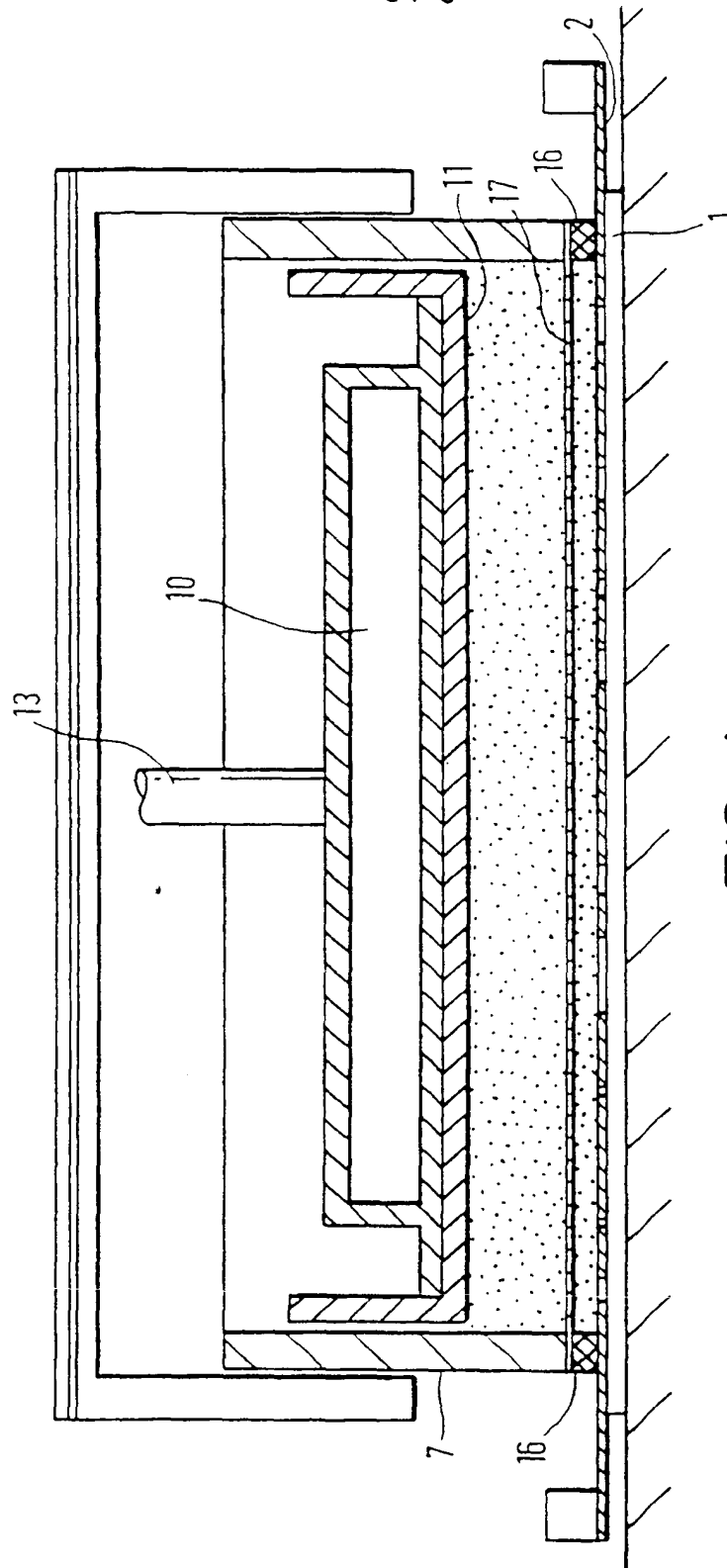


FIG. 4

6 / 8

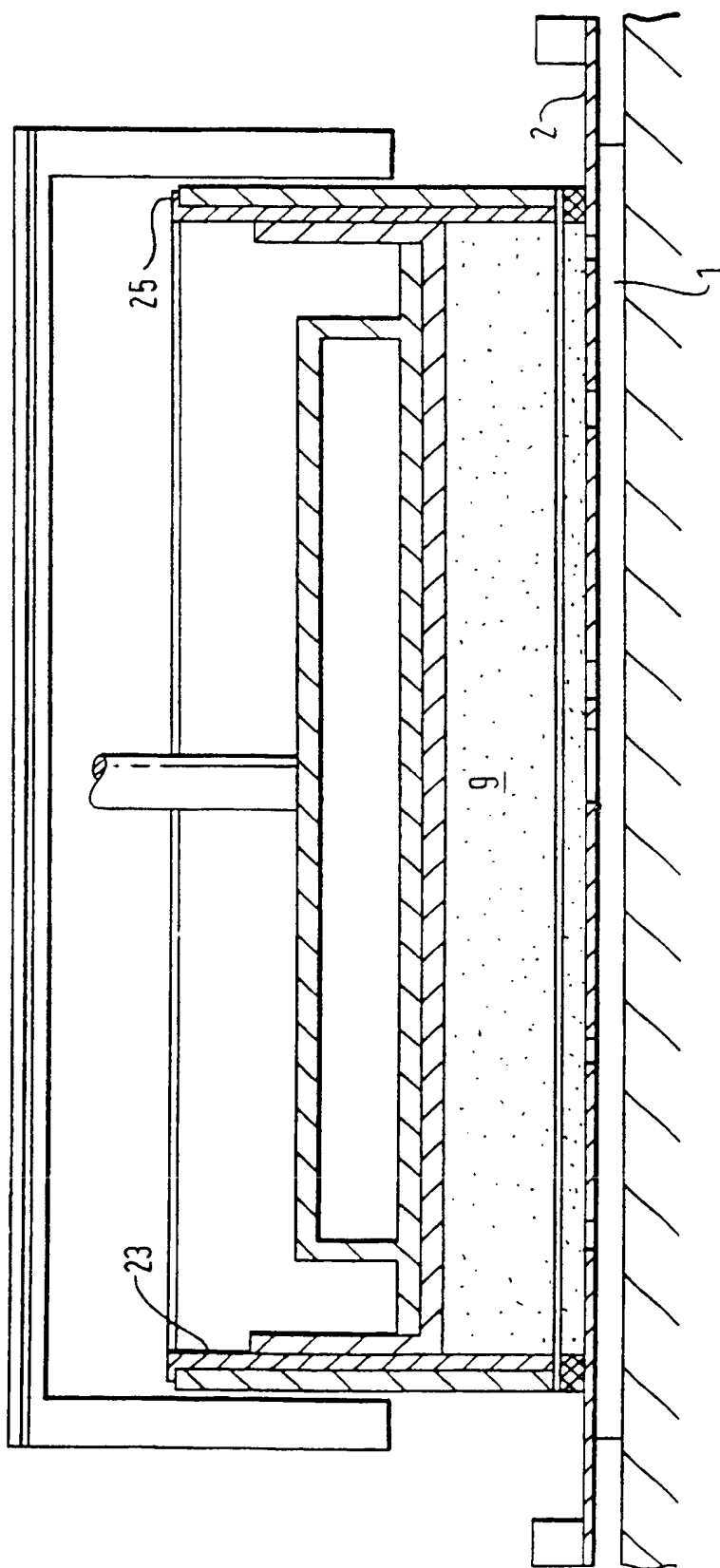


FIG. 10

8 / 8

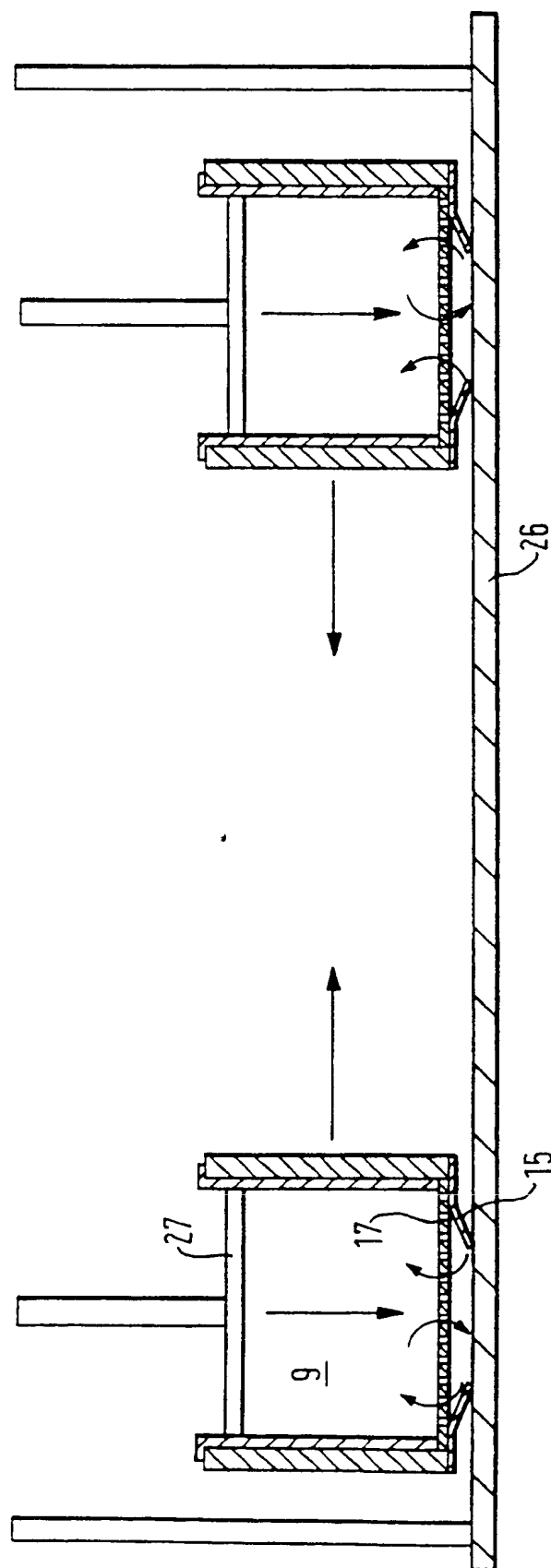


FIG. 13

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/97/05761

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 B41F15/42 H05K3/12 B41M1/12 B05D1/32 B05D1/26

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 B41M B05D B05C B41F H05K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages  | Relevant to claim No.                    |
|------------|---|--|
| X          | WO 96 20088 A (FORD MOTOR CO ; FORD MOTOR CO (GB); FORD MOTOR CANADA (CA)) 4 July 1996<br>cited in the application<br>see the whole document<br>--- | 1-4, 6-9,<br>12,<br>29-34,<br>36-39, 41  |
| X          | CH 648 497 A (BILLETER KUNSTSTOFFPULVER AG) 29 March 1985<br><br>see the whole document<br>---  | 1, 2, 6-8,<br>17, 18,<br>30-34,<br>36-38 |
| X          | US 4 622 239 A (SCHOENTHALER DAVID ET AL)' 11 November 1986<br><br>see the whole document<br>---  | 1-4, 6-8,<br>14,<br>29-38, 41            |
|            | -/-   |  |

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

### \* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

17 February 1998

Date of mailing of the international search report

24/02/1998

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Brothier, J-A

## INTERNATIONAL SEARCH REPORT

Int. Patent Application No.

PCT 97/05761

## C. (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document, with indication, where appropriate, of the relevant passages             | Relevant to claim No.                             |
|----------|--|---|
| X        | US 4 720 402 A (WOJCIK THADDEUS) 19<br>January 1988<br><br>see the whole document<br>---       | 1-4, 6-8,<br>14,<br>29-38, 41                     |
| X        | GB 1 433 957 A (MITTER & CO) 28 April 1976<br><br>see the whole document<br>---                | 1, 2, 6-8,<br>30-34,<br>36-38                     |
| X        | DE 22 50 092 A (KUESTERS EDUARD) 18 April<br>1974<br><br>see the whole document<br>---         | 1, 2, 6-8,<br>13, 14,<br>16,<br>30-34,<br>36-38   |
| X        | US 4 023 486 A (LINTHICUM HERBERT W ET AL)<br>17 May 1977<br><br>see the whole document<br>--- | 1, 2, 6-9,<br>11,<br>13-16,<br>30-34,<br>36-39    |
| X        | US 3 921 521 A (KUDLICH HANS) 25 November<br>1975<br><br>see the whole document<br>---         | 1, 6-8,<br>14,<br>30-34, 38                       |
| X        | US 3 656 428 A (DUNCAN GEORGE A) 18 April<br>1972<br><br>see the whole document<br>---         | 1-3, 5, 6,<br>8, 13, 14,<br>16, 30,<br>31, 36, 38 |
| A        | US 3 384 931 A (COCHRAN THOMAS J ET AL) 28<br>May 1968<br>see the whole document<br>-----      | 29, 41  |

# INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT 97/05761

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s)   | Publication<br>date  |
|---|---------------------|--|--|
| WO 9620088 A                              | 04-07-96            | CA 2213818 A<br>EP 0800457 A   | 04-07-96<br>15-10-97   |
| CH 648497 A                               | 29-03-85            | NONE   |  |
| US 4622239 A                              | 11-11-86            | CA 1258013 A<br>JP 1705774 C<br>JP 3076191 B<br>JP 62201672 A                                | 01-08-89<br>27-10-92<br>04-12-91<br>05-09-87                         |
| US 4720402 A                              | 19-01-88            | NONE   |  |
| GB 1433957 A                              | 28-04-76            | NONE   |  |
| DE 2250092 A                              | 18-04-74            | NONE   |  |
| US 4023486 A                              | 17-05-77            | NONE   |  |
| US 3921521 A                              | 25-11-75            | US 3807302 A<br>DE 2134983 A<br>DE 2163179 A<br>FR 2105818 A<br>GB 1363497 A<br>NL 7110042 A | 30-04-74<br>03-02-72<br>29-06-72<br>28-04-72<br>14-08-74<br>25-01-72 |
| US 3656428 A                              | 18-04-72            | NONE   |  |
| US 3384931 A                              | 28-05-68            | DE 1640535 A   | 26-11-70   |